

CLAIMS

What is claimed is:

1. A self-piercing rivet for coupling a plurality of workpieces comprising:

a flange with a first diameter and a shank with a hollow cavity extending from the flange, wherein the shank is a straight cylinder with outer diameter smaller than the first diameter, the shank defining a hollow cavity, and a conical section tapered from a shank end and converging towards the flange at angle α and a straight cylinder section with an inner diameter extending from the conical section, wherein the shank has a substantially flat ring-shaped end surface with an outer diameter and radial length, and wherein the angle α of the conical section ranges between about 70° and about 110°.

2. The self-piercing rivet in accordance with Claim 1, wherein the thickness of the shank at the straight cylinder section of the hollow cavity is 25 to 45% of the outer diameter of the shank.

3. The self-piercing rivet in Claim 2, wherein the axial length of the flange is 5 to 20% of the outer diameter of the shank.

4. The self-piercing rivet in accordance with Claim 3, wherein the entire length of the shank is the sum of the overall thickness of the workpieces and a die thickness of the rivet fastening device.

5. The self-piercing rivet in accordance with Claim 4, wherein the entire length of the hollow cavity in the shank is greater than 70% of the overall thickness of the workpieces.

6. The self-piercing rivet in accordance with Claim 1, wherein the radial length of the end surface of the shank is between 0.2 mm and 0.6 mm.

7. The self-piercing rivet in accordance with Claim 1, wherein the entire rivet is heat treated to prevent stress corrosion.

8. The self-piercing rivet in accordance with Claim 5, wherein the radial length of the end surface of the shank is between 0.2mm and 0.6mm.

9. A method of coupling a pair of workpieces comprising:

providing a fastener having a flange with a large diameter and a shank with a hollow cavity extending from the flange, wherein the shank is a straight cylinder with outer diameter defining a hollow cavity, the shank defining a conical section tapered from a shank end and converging towards the flange at angle α and a straight cylinder section with inner diameter extending from the conical section to an end on the flange side, wherein the shank has a substantially flat ring-shaped end with outer diameter and radial length, and wherein the angle α of the conical section ranges between 70° and 110°; and

striking the fastener so as to deform and expand the shank outwardly in a radial direction.

10. The method according to Claim 9, wherein the fastener is an aluminum alloy.

11. The method according to Claim 10, wherein the fastener is an aluminum-zinc alloy.

12. The method according to Claim 10, further including reducing the temperature of the fastener to less than -100°C.

13. The method according to Claim 10, wherein striking the fastener is striking the fastener so as to form an undercut.

14. A self-piercing rivet for coupling a plurality of workpieces comprising:

a flange;

a shank having a body with an outer radius smaller than a radius of the flange, the shank defining a hollow cavity, the shank having a conical tapered section having an angle between 70° and 110°.

15. The self-piercing rivet according to Claim 14, wherein the hollow cavity has a diameter of 25 to 45% of the outer radius.

16. The self-piercing rivet according to Claim 14, wherein the length of the flange is 5 to 20% of the diameter of the outer diameter.

17. The self-piercing rivet according to Claim 14, defining a flat end surface adjacent the conical tapered section, wherein the radial length of the end surface of the shank is between about 0.2 and 0.6 mm.

18. The self-piercing rivet according to Claim 14 wherein the pair of workpieces have a first thickness and wherein the cavity has a length of the 70% of the first thickness.

19. A self-piercing fastener for coupling a plurality of workpieces comprising:

a cylindrical shank body defining a hollow cavity, said cavity defining a conical tapered section having an angle between about 70° and about 110°, said cavity further defining an upper end defining a concave surface.

20. The self-piercing fastener of Claim 19, wherein the concave surface defines an interior angle of about 160°.

21. The self-piercing fastener of Claim 19, wherein the shank further comprises a flat ring-shaped end surface adjacent the conical tapered section.

22. The self-piercing fastener of Claim 19 wherein the shank defines a thickness between a shank outer surface and a shank inner surface, the thickness being between about 20% to about 45% of an outer diameter of the shank outer surface.

23. The self-piercing fastener of Claim 19 wherein the fastener is an iron alloy.